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मानक

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IS 12244-2 (1988): Colorimeter thermometers, Part 2:  
Enclosed scale thermometers [CHD 10: Glassware]



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Indian Standard

SPECIFICATION FOR

CALORIMETER THERMOMETERS

PART 2 ENCLOSED SCALE THERMOMETERS

1. **Scope** — Prescribes the requirements for a series of short-range enclosed-scale calorimeter thermometers, graduated for vertical, total and partial immersion, for use in bomb calorimetry and other purposes where an accurate measurement of change of temperature required.
2. **Terminology** — For the purpose of this standard, the definitions given in IS : 2627-1979 'Glossary of terms relating to liquid-in-glass thermometer ( first revision )' shall apply.
3. **Type** — The thermometers shall be of the mercury-in-glass enclosed-scale type ( see Fig. 1 ).

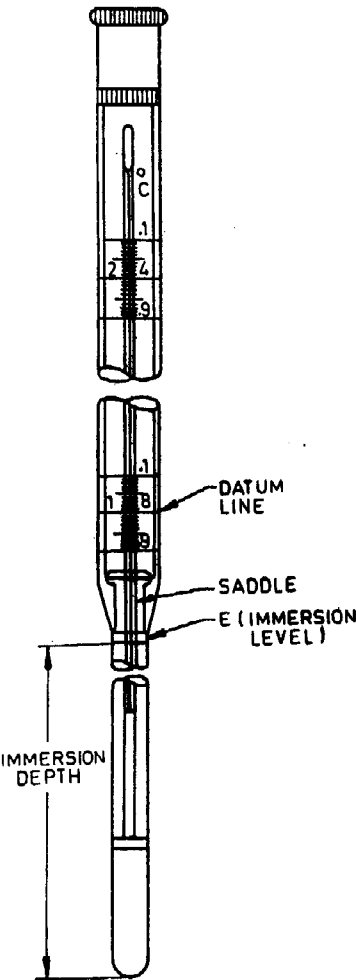


FIG. 1 CALORIMETER THERMOMETER — ENCLOSED-SCALE TYPE

4. Calibration and Immersion

4.1 The thermometers shall be calibrated in degrees Celsius.

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BUREAU OF INDIAN STANDARDS  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

Laboratoryware and Related Apparatus Sectional Committee, CDC 33; Thermometers Subcommittee, CDC 33 : 2 [ Ref : Doc : CDC 33 ( 8787 ) ]

**4.2** The thermometers shall preferably be calibrated for use at total immersion ( that is, the reading is taken when the thermometer is vertical and immersed at least to the end of the liquid column in the medium where temperature is required to be measured ). The calibration for use at partial immersion is permitted, if agreed to between the purchaser and the supplier. On partial immersion thermometers, a line shall be etched at least half way round the stem of the thermometer at level to which it is intended to be immersed; which would preferably be the junction of the saddle and the sheath ( marked, *E* in Fig. 1 ).

## 5. Requirements

### 5.1 Materials

**5.1.1 Glass** — The thermometer bulb shall be made of suitable thermometric glass ( see IS : 4610-1968 'Specification for glass tubes for general purposes and reference thermometers' ). The glass or glasses comprising the thermometer shall be so selected and processed that the finished thermometer shows the following characteristics:

- Stress in the glass shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock;
- The correction of the thermometer reading at the lowest temperature of the nominal range shall not change by more than 0.02°C immediately after the thermometer has been heated for 15 min at a temperature 30°C higher than the lowest temperature and allowed to cool naturally in air;
- The legibility of the reading shall not be impaired by devitrification or clouding;
- The meniscus shall not be distorted by defects or impurities in the glass.

**5.1.2 Thermometric liquid** — The recommended liquid is pure and dry mercury free from entrapped gases.

**5.1.3 Gas filling** — Above the mercury, thermometers may be either vacuum or gas-filled; in the latter case, only a dry, inert gas shall be used. The indication in a gas-filled thermometer, when the meniscus is at the top of the scale, shall not change by more than 0.01°C when the temperature of the gas above the mercury is changed by 30°C.

**Note** — It is generally possible for this requirement to be satisfied if the internal pressure does not exceed 0.5 bar\*, when the thermometer is registering its maximum temperature.

### 5.2 Construction

**5.2.1 Shape** — The thermometers shall be straight and their external cross-section approximately circular.

**5.2.2 Top finish** — The top of the sheath shall be sealed by fusing and shall be covered by metal cap.

**5.2.3 Strip bearing the scale** — The strip bearing the scale shall be of a material suitable to the temperature to be measured and compatible with the method of fixing the strip. It shall be placed tightly against the capillary tube inside the sheath and shall be firmly and securely fastened at the top of the thermometer. A suitable method of fixing is by fusing a glass tube or rod to the sheath and to the upper end of the strip bearing the scale; the lower end of the strip shall be freely held in a suitable glass saddle. Alternatively, it shall be fixed inside the sheath in any other suitable manner that allows for differential expansion.

**5.2.4 Capillary tube** — The inside of the capillary tube shall be smooth. The cross-sectional area of the bore shall not show variations from the average greater than 5 percent and the bore shall be wide enough to ensure that, without tapping, jumping of the meniscus does not exceed one half of the graduation interval when the temperature is rising at a uniform rate not exceeding 0.05°C per minute. In the case of thermometers calibrated for use at partial immersion, the volume of mercury contained in the capillary tube between the immersion line and the lowest figured scale line shall not exceed the equivalent of 2°C.

**5.2.5 Expansion chamber ( safety chamber )** — The capillary tube shall have an enlargement at the top of sufficient size to allow heating of the thermometer to 70°C. This expansion chamber shall be pear-shaped, with the hemisphere at the top. It shall be so shaped that the meniscus remains in the narrow portion at temperatures up to 40°C.

**5.2.6 Construction Chamber** — A contraction chamber shall be provided so that the mercury does not recede into the bulb at 0°C. It shall be elongated and as narrow as possible.

\*1 bar = 10<sup>5</sup> Pa

**5.2.7 Enlargement of the bore** — No enlargement of the bore shall be so located as to produce a variation in the cross-section of the capillary tube in the scale portion greater than that permitted in 5.2.4.

**5.2.8 Dimensions** — The dimensions of the thermometers shall be as given in Table 1.

**TABLE 1 DIMENSIONS OF ENCLOSED SCALE CALORIMETER THERMOMETERS**  
( Clause 5.2.8 )

SI No.	Requirement	Dimensions in mm
(1)	(2)	(3)
i)	Total length, <i>Max</i>	760
ii)	Distance from bottom of bulb to top of construction chamber, <i>Max</i>	110
iii)	Distance from bottom of bulb to lower nominal limit of scale	280 to 300
iv)	Length of main scale ( nominal limits ), <i>Min</i>	300
v)	Distance from upper nominal limit of scale to top of thermometer, <i>Min</i>	70
vi)	Diameter of sheath, <i>Max</i>	15
vii)	External diameter of bulb and adjoining portion of stem	9 to 11
viii)	Length of bulb to shoulder, <i>Min</i>	40

## 6. Graduation and Figuring

**6.1** The scales and graduation interval of the thermometers shall be as given in Table 2.

**TABLE 2 GRADUATION OF ENCLOSED SCALE CALORIMETER THERMOMETERS**  
( Clause 6.1 )

SI No.	Schedule No.	Graduation Interval °C	Nominal Scale Range °C
(1)	(2)	(3)	(4)
i)	1	0.01	9 to 15
ii)	2	0.01	12 to 18
iii)	3	0.01	15 to 21
iv)	4	0.01	18 to 24
v)	5	0.01	21 to 27
vi)	6	0.01	24 to 30
vii)	7	0.01	27 to 33
viii)	8	0.01	30 to 36
ix)	9	0.01	33 to 39
x)	10	0.01	36 to 42
xi)	11	0.01	39 to 45

**6.2** The scale lines shall be clearly etched/marked and of uniform thickness, which in no case shall exceed 0.05 mm. The lines shall lie in planes at right angles to the axis of the thermometer.

**6.3** The arrangement and figuring of the scale lines shall be according to Fig. 2. Each 0.1°C scale line shall be a long line, each 0.05°C line shall have a length of two-thirds of the long lines. The figures shall be placed immediately above the line to which they refer.

**6.4** The scale of the thermometer shall be extended by ten divisions ( that is, 0.1°C ) beyond the nominal limits given in Table 2.

**6.5** The scale shall be figured at each division of 0.1°C. Full figuring shall be provided at least at each division of 1°C and more frequently, if required.

**6.6** The pigment filling of the scale lines, figures and inscriptions shall be clearly visible.

**6.7 Datum Line** — At the right-hand side of the sheath, an indelible datum line shall be placed on a level with the lowest nominal scale line so that any displacement of the scale can easily be noticed.

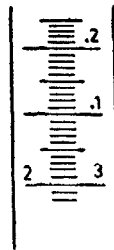


FIG. 2 GRADUATION AND FIGURING

## 7. Accuracy

**7.1 Scale Error** — The scale error, when the thermometer is under normal atmospheric pressure and when the emergent liquid column ( in the case of a partial immersion thermometer ) is at the prescribed temperature, shall not be greater than  $0.1^{\circ}\text{C}$ .

**7.2 Internal Error** — The absolute value of the algebraic difference between the error at any two points which are not more than 50 divisions apart shall in no case be greater than  $0.01^{\circ}\text{C}$ .

## 8. Marking and Packing

**8.1 Marking** — Each thermometer shall be marked permanently and legibly with the following:

- The letter 'C' near the top of the scale;
- Manufacturer's name or recognized trade-mark, if any;
- Serial number of the thermometer;
- Schedule No.;
- Schedule mark followed by letters 'TI' or 'PI', as the case may be;
- Gas filling, if any; for example, NF for nitrogen filled; and
- Immersion line* — On each thermometer graduated for use at partial immersion, the immersion depth shall be indicated and the emergent stem temperature for which the thermometer was calibrated shall be marked.

**8.1 Certification Marking** — Details available with the Bureau of Indian Standards.

**8.2 Packing** — Each thermometer shall be suitably packed as agreed to between the purchaser and the supplier

## 9. Testing and Inspection

**9.1** Each thermometer shall be tested for conformity to all the requirements of this specification. The accuracy test shall be carried out in accordance with IS : 6274-1971 'Method of calibrating liquid-in-glass thermometer'.

## EXPLANATORY NOTE

This standard is based on ISO 652-1975 'Enclosed-scale calorimeter thermometers', issued by the International Organization for Standardization ( ISO ).

The calorimeters, not provided with auxiliary scales at  $0^{\circ}\text{C}$ , are therefore not suited to the absolute measurement of temperature, unless they are checked against a standard thermometer immediately before use. The solid-stem calorimeter thermometers are covered in Part 1 of the standard.